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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[a]

HANDLING SEED CORN.[b]

The proper care and handling of seed corn after its selection is a very important part of its preparation for use. The low vitality of seed corn so frequently shown in the spring when the germination tests are made is due in many cases to improper handling and storing during the fall and winter months. The stand, the thriftiness of the plants, and, in consequence, the yield of the next year's crop depend so largely upon proper storage, and so much time and labor have been spent in the selection and gathering of the seed ears, that carelessness in handling and storing this most important and most valuable part of the season's production is equivalent to inviting a financial loss. The care given to seed corn is the most remunerative work on the farm.

In connection with experiment station work for a better stand of corn and a higher average yield the subject of storing seed corn has received the attention commensurate with its importance. During the past two seasons the Iowa Station examined a large number of samples of seed corn secured from different parts of the State and found that, on the average, these samples fell far below the standard of vitality. The corn had apparently dried out well in the fall, and that a large percentage of it should have been killed by spring was not at all expected. However, it was found that often one ear was good and the very next one poor; one side of an ear alive and the other dead; and frequently one kernel on an ear would grow while the next one to it would not. This condition is considered as probably due to slow, imperfect ripening and insufficient drying in the fall; to improper storage during fall and winter, and to unusually cold weather late in November and early in December, which killed or weakened the germ by freezing the kernels while they still contained considerable moisture. The seed corn that had been stored in dry and well-ventilated places before October 20 was found to be in good condition. When first gathered seed corn frequently contains about 25 per cent of moisture, but shrinkage experiments conducted by this station

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Iowa Sta. Bul. 77; Nebraska Sta. Bul. 91.

showed that the general crop at the beginning of the cribbing season during these years contained on an average about 36 per cent of water. Dry weather in October had dried the exterior of the ears, giving them the appearance of being perfectly dry when in fact the interior of the kernels and the cob still contained considerable moisture; and where the greatest care was not taken to store the corn under most favorable conditions, the vitality was largely reduced.

During the last season more than 3,300 samples of seed corn from different parts of Iowa, each sample being made up of 200 kernels taken from 100 ears of seed corn, were given careful germination tests at the station with the result that only about 60 per cent of this corn showed sufficient vitality for field planting, while approximately 20 per cent gave a weak germination and the rest did not germinate at all. It is obvious that a very imperfect stand and an inferior crop must result from the use of seed corn of which only about 60 of each 100 kernels are capable of producing normal plants. Attention is called to the fact that weakened kernels, although giving a fair germination, often fail to grow if the weather conditions after planting are not very favorable, and that in any case a weakened seed kernel is likely to produce a weak plant.

T. L. Lyon, of the Nebraska Station, found that seed corn put in an ordinary crib and stored there over winter showed in a field test the following spring only 70 per cent germination, while some of the same crop stored in a dry seed room showed 90 per cent.

With this experience and these results in view, P. G. Holden, of the Iowa Station, recommends that seed ears be selected and harvested not later than October 15 to 20, and immediately hung up in an open shed where the sun can not shine on them, but where they can otherwise have the best possible conditions for drying out quickly and thoroughly. The plan suggested is to tie eight or ten ears in a string with binding twine, or to tie them together in pairs, and to hang them on wires or strips put up for the purpose. Seed corn hung up in this way is largely out of danger from mice and rats and usually dries sufficiently in about two weeks to be taken down and stored for the winter. It is advised to take the corn down as soon as it is dry enough and before any hard freezes occur and store it in some dry place having a good circulation of air, as in the attic or the furnace room, where it will be subject neither to injurious moisture conditions nor the severe freezing weather of late fall and early winter. It is pointed out that if the corn has become perfectly dry it may be left in the open shed all winter without danger of injury from freezing, but that in moist, cold seasons if not hung up to dry before October 20 the only safe method of handling it is to take it down and store it as described. When seed corn is not harvested

until in November, which is too often the case, it should be taken directly to some place where it can be protected from freezing by artificial heat and where there is good circulation of air.

On this point Professor Lyon says:

Every farmer should husk his seed corn early in the fall, but after it has completely ripened, and see that it is thoroughly dry before freezing weather. A fairly good drying rack can be made by fastening 2 by 4 scantling above the floor in an ordinary crib. Lay narrow boards on these with wide cracks between them. The seed corn should be placed on this about 1 or 2 feet deep. Make several racks, one above the other.

There are several cautions which should be observed in the storing of seed corn. Do not put immature or freshly gathered seed corn in a warm room on the floor or in piles. It will either sprout or mold or both. The corn should be hung up and the windows left open for the circulation of air.

Seed corn should not be left in barrels and boxes nor on the floor or porch in piles. It should be properly taken care of as soon as harvested.

Do not store seed corn over the laundry room nor over the stable, as it will gather moisture and be injured by freezing.

The most critical time for seed corn is during the first month after it is harvested, while it is green and sappy. There is danger that it will mold or grow if the room is warm and the circulation of the air is not good or if the corn is put in piles. On the other hand there is danger of its freezing unless protected.

The above statements show quite plainly that if special pains have not been taken during the preceding fall and winter to protect the seed corn from the numerous agencies which may reduce or destroy its vitality, it should not be a matter of surprise if low germinating power and poor stands are the result when the seed is planted in the spring, and this emphasizes the importance of careful germination tests of the seed before it is planted.[a]

ADAPTATION OF CORN TO A NEW LOCALITY.[b]

In a previous bulletin of this series[c] there is the following comment on certain observations which had been made at the Nebraska Station on the superiority of home-grown wheat seed over that brought from a distance:

These results are a notable addition to the rapidly accumulating evidence that locally developed seed is the most reliable, and that individual farmers should give more attention to the production of their own seed. The bringing of high-priced, high-bred seed from a distance—however valuable the seed may be under the conditions of soil, climate, etc., under which it was produced—is more than likely to prove a disappointment under the changed environment. The best seed for any locality is that wisely selected and carefully bred under the conditions peculiar to that locality.

[a] For full directions for making such tests see U. S. Dept. Agr., Farmers' Bul. 229.

[b] Compiled from Nebraska Sta. Bul. 91.

[c] U. S. Dept. Agr., Farmers' Bul. 237, p. 11.

In a recent bulletin of the Nebraska Station reporting a series of experiments of different kinds on corn, T. L. Lyon makes the following statements, which have a most important bearing on the same general subject:

When corn grown in one section of the country for a number of years is moved to another section where soil and climate are different the plant always undergoes more or less change during the first two or three years before it becomes "adapted" to its new conditions.

The definite effect of climate in modifying the corn plant is shown in the following experiment: Seed of two varieties of corn, Snowflake White and Iowa Gold Mine, was obtained from Iowa and grown in Nebraska for two years. In the third year seed was taken from this, and seed was also obtained from the same original source in Iowa. These were all planted in adjacent plats at the experiment station. A marked difference was shown throughout the experiment between the different plats. In the Snowflake White variety the stalk from the seed that had grown in central Nebraska for two years had decreased almost a foot in height, the ear was 8.8 inches lower down and the ear shank almost 2 inches shorter, while the plants from Nebraska seed had an average of 1.2 fewer leaves.

The weight of both stalk and ear was found to be heavier in the corn grown from the seed just from Iowa, but the proportion of ear to stalk was higher in the acclimated corn. The Nebraska corn averaged almost 200 square inches less leaf area, which was to be expected of plants grown in a drier climate. The yield of grain was in favor of the home-grown seed.

Similar conclusions were indicated from the variety tests * * * Of the 22 varieties that were tested by the cooperating farmers in various parts of the State, 13 were Nebraska grown, 4 were from Illinois, 2 from Iowa, 1 from Indiana, and 2 from Minnesota. In these experiments the significant fact was revealed that not one of the 9 varieties the seed of which was grown outside the State ever took first or even second place in the average results for the State. These results do not indicate that the varieties from the other States are poorer seed than our own. Their low yield is due to the fact that they are not at first adapted or acclimatized to Nebraska conditions.

The lesson to be learned from this is that to get the best results in corn growing the seed must be home-grown, and grown not only in the same State but in the same locality. The results of the variety tests indicate that seed grown in eastern Nebraska will not do as well in western Nebraska as local varieties, and vice versa. There should be careful growers of seed in every county of the State.

ROOT NODULES AS AFFECTING THE COMPOSITION OF SOY BEANS AND COWPEAS.[a]

The nodules or tubercles found on the roots of leguminous crops and the microscopic organisms which cause them have been quite extensively studied and much valuable information regarding their significance has been secured. It has been found that the organisms found in these nodules enable the leguminous plants to feed upon the nitrogen of the air, thus explaining why such plants are so valuable

[a] Compiled from Michigan Sta. Bul. 224.

as means of increasing the fertility of the soil. Attempts have been made to utilize this knowledge in increasing the growth of leguminous plants by inoculating the soil or the seed with pure cultures of the root tubercle organisms.[a] In this work, however, the effect of inoculation has been measured by the increase in yield, and no account has been taken of the effect on the composition and quality of the crop.

In experiments recently reported by the Michigan Station, the influence of the nodule organisms on the appearance of growing crops of soy beans and cowpeas and on the quantity and quality of the product was studied, the main question being how does the presence of nodules on the roots affect the composition of the plants.

For three years at the station decided differences in color and thrift between plants on the same plat were observed, and in some instances limited areas produced darker colored and, in general, more thrifty appearing plants than the rest of the plat. An examination of soybean plants from a certain area conspicuous for its dark-green color showed that the roots of these plants were not provided with nodules. A similar test in an inoculated field failed to disclose a relation between the presence of nodules on the roots and the dark-green color of the plants. Neither was there a difference in this case in the size of the nodules or their number on the dark-colored plants as compared with those light in color. Equal areas of soy beans and cowpeas inoculated and with nodules on the roots and uninoculated, did not show any considerable increase in yield as the result of inoculation.

In studying the influence of the presence of nodules on the composition, two areas of medium-green soy beans were grown in 1903 and the yield and composition of roots, stems, and leaves were determined. The crop obtained on one area was practically free from nodules, while the roots of the plants from the other were nearly covered with them. Eight feet were measured off from the average rows in each area and the leaves and stems from the section of the row bearing nodules weighed 5.125 pounds, as compared with 5.562 pounds from the section without nodules. The roots with nodules weighed 0.438 and those without, 0.625 pounds, the nodules themselves weighing only 0.16 pound.

This work was repeated the next season on two plats, each containing a square rod, the one being inoculated with soil from a soybean field and the other being left without inoculation. The plants produced on the inoculated plat were well covered with nodules, while those on the uninoculated plat remained free from them. No difference was apparent in the growth on the two plats or in the color of the foliage. Eight feet of row on the inoculated plat contained 52

[a] U. S. Dept. Agr., Farmers' Bul. 240.

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plants, weighing 4 pounds 5 ounces, and on the uninoculated plat, 49 plants, weighing 3 pounds 12 ounces, the roots weighing 9 and 6 ounces, respectively.

On the average for the two years the leaves and stems of the plants provided with nodules contained 2.78 per cent of nitrogen and the others 1.77 per cent in the dry matter. The nodule-bearing roots with the nodules removed averaged 1.01 per cent of nitrogen in the dry matter and those having no nodules, 1.43 per cent. Inoculation did not seem to notably affect the content of phosphoric acid or of potash. In each year the percentage of protein was higher in the inoculated plants, the protein content for the two years taken together being 56.86 per cent greater in the plants from the inoculated plats.

A similar experiment with cowpeas in 1904 showed a corresponding predominance of nitrogen in the leaves and stems where nodules were produced and a decrease in the roots. The cowpeas with nodules on the roots contained 47 per cent more protein than those without nodules.

In studying the chemical composition of the root nodules it was found that soy-bean nodules contained 4.19 per cent of nitrogen, equivalent to 26.19 per cent of protein and 2.05 per cent of potash; and cowpea nodules 3.90 per cent of nitrogen, equivalent to 24.39 per cent of protein and 0.96 per cent of phosphoric acid. In all except one case the roots without nodules contained a greater percentage of nitrogen than the roots provided with them.

Basing calculations on the composition of dry matter of the leaves, stems, and roots of the two crops, it is estimated that the inoculated soy beans contained 113.55 pounds of nitrogen per acre, as compared with 75.98 pounds from the uninoculated, and the inoculated cowpeas 139.21 pounds, as compared with 118.45 pounds in the uninoculated crop. The figure for the cowpeas does not include the nitrogen in the abundant nodules.

The influence of nodules on the composition of the seed of soy beans is shown in the fact that the ripened seeds of the inoculated soy beans were fully 16 per cent richer in protein than the product of the uninoculated areas.

From the results of these various experiments and observations it is concluded that, while the nodules on the roots of these crops on fairly fertile soil may not noticeably increase the yield, they may increase to an important extent the relative and absolute amounts of nitrogen in the plants and thus add to their value as green manures and as food.

FUMIGATION OF NURSERY STOCK.[a]

The inspection laws of most States require that nursery stock should be fumigated with hydrocyanic-acid gas, and prescribe the conditions under which fumigation should be done. This treatment has been found so effective against San José scale, other scale insects, and other insect pests which may be disseminated on nursery stock that practically all nurserymen have realized the importance of fumigation, and have erected fumigating houses according to plans dictated by past experience. In such fumigating houses, not only all deciduous fruit trees 1, 2, 3, or more years of age are treated, but also buds and scions removed from trees of the nurserymen's premises and intended for sale. In short, fumigation has come to be recognized as one of the necessary parts of the general routine of nursery work. The history of the use of this method is so generally known that it is not necessary to discuss the matter in this connection.

Recently a considerable number of complaints have been made by fruit raisers and nurserymen that fumigation injures the trees subjected to the process. In some localities this fear of injury from hydrocyanic-acid gas has become so widely distributed that fruit growers prefer to take chances of getting infested trees rather than have them submitted to fumigation. On account of this attitude of fruit growers and nurserymen it seemed desirable to investigate anew the effect of hydrocyanic-acid gas upon nursery stock.

Quite elaborate experiments were carried out by Lowe and Parrott, of the New York State Station, to gain information on the effect of the gas on fruit buds. In these experiments from 0.18 to 0.3 gram of cyanid was used per cubic foot of space on apple buds. Of the treated buds 80.6 per cent lived, while 84.3 per cent of the untreated buds set successfully. Similar experiments with cherry, pear, peach, and plum buds indicated a slight advantage in every case in favor of the untreated buds. The difference, however, except in the case of peach buds, was not great enough to indicate any decided injury from the gas. In all the experiments under discussion the conditions under which the buds were placed after fumigation were so unfavorable as to allow part of the percentage of loss to be attributed to these conditions. In the case of peaches the use of 0.22 gram of cyanid per cubic foot of space during the fumigation period of one hour did no harm whatever; in fact the percentage of treated buds which lived was greater than those of the checks. When, however, 0.3 gram of cyanid per cubic foot was used there was considerable injury, only 70 per cent of the treated buds living, as against 82.8

[a] Compiled from Maryland Sta. Bul. 105; New York State Sta. Bul. 202, pp. 188–205; and other sources.

per cent of the checks. The growth of the treated peach buds, however, was in nearly every instance equal to that of the untreated buds.

During the past winter Burgess, in Ohio, Symons, in Maryland, and Phillips, in Virginia, undertook experiments independently to determine the effect of fumigation upon ordinary nursery stock. The conclusions reached by these investigators were almost identical and, since the work of each man was carried on without knowledge of the existence of other similar experiments in progress, the results served to corroborate one another. The principal conclusion was that fumigation, as recommended and carried out by nursery inspectors, does not injure well-matured nursery stock.

In Maryland 3,000 nursery trees were fumigated, one-half in the fall and one-half in the spring. These trees were apple and peach. The amount of cyanid used varied from a quantity below the normal to six times the amount usually recommended for fumigating nursery stock. In order to test the effect of the time of exposure, one-half of the trees was fumigated for thirty minutes and the other for one hour. The results obtained from these experiments indicate that no injury was caused dormant apple and peach nursery stock two years or more of age even with a strength of gas and period of exposure considerably greater than that commonly prescribed by inspectors. Since these experiments were carried on in fumigating houses at the nurseries where the trees were dug, it appears that there is no danger of injury to nursery stock by fumigation at the nursery. By the use of excessive strengths of cyanid it was shown that there is apparently more danger of injury in fumigating in the fall than in the spring. In the fumigation tests carried on in the fall peach trees appeared to be more resistant to the effect of the gas than apple trees. A slight difference in the resisting power of different varieties of apples was noted, the Yellow Transparent being most resistant, while Winesap, Ben Davis, Maiden Blush, and York Imperial were apparently more likely to be injured.

The injury in any case, however, from fumigation, even with excessive strengths of cyanid, was so slight that, taken in connection with the unfavorable conditions surrounding the trees at fumigation, Mr. Symons is disposed to disregard it entirely. At a recent meeting of the Association of Official Horticultural Inspectors similar testimony was presented from other States. Mr. Webb, of Delaware, stated that he had never seen any injury from fumigation in the several hundred thousand trees which had been treated with hydrocyanic-acid gas in Delaware. Judging, therefore, from evidence thus far obtained by investigators at experiment stations and elsewhere, there seems to be no occasion to fear serious injury to nursery trees from fumigation with hydrocyanic-acid gas.

THE COOKING QUALITY OF POTATOES AND FACTORS WHICH AFFECT IT.[a]

In a great majority of the investigations carried on by agricultural experiment station workers and other investigators of different methods of potato culture, the relative value of different fertilizers, the comparative merits of different varieties, and related questions, with special reference to yield, appearance, and shipping and keeping qualities, have been the factors most commonly taken into account. It is true that in a great many cases the composition of the tubers and especially their starch content has been studied, as this has a recognized bearing on commercial value. However, it is very seldom that the potato has been followed to the kitchen and its cooking qualities passed upon. The bulk of the potato crop in the United States is used as food; so it seems obvious that texture, color, flavor, and other similar factors are of the utmost importance, and excellence in these lines should be sought in addition to the qualities which more generally receive consideration.

What constitutes excellence in Great Britain may be gathered from the following statements by Prof. R. P. Wright:[b]

> Good quality in the potato means the capacity of boiling well; that is, of bursting through the skins in a dry and mealy condition when properly boiled, of being white in color of such shade as the variety allows and free from any discoloration, and of having a good smell and flavor. Potatoes of poor flavor or strong odor, or that show yellowish color, or that are watery or waxy in texture are all regarded as of bad quality. It is obvious that in the determination of quality chemical analysis can give no assistance in the determination of variations in flavor and color, and that observations on these properties must be made with the eye and the palate, with such liability to error as must exist under such conditions. But as quality in the potato is also largely dependent on the dryness of the tubers, chemical analysis can throw very useful light on the question by determining the relative amounts of moisture and of solids present in them. It can give still more important help, however, by determining the exact percentage of starch. According to Wolff, the dry, mealy condition of the potato tubers, which is so much desired, is largely dependent on the amount of starch contained in them. A high percentage of nitrogenous matter may be found in watery potatoes of inferior quality grown on damp clay soils, while potatoes of good quality grown on a sandy soil would show a lower percentage of nitrogenous matter along with a larger quantity of starch. Good quality in the potato, therefore, is in great measure dependent on the presence of a high percentage of starch.

In the United States a potato having a starchy flavor, white in color, and mealy when cooked is considered more desirable than one which is strong in flavor and dark-colored or soggy after boiling.

[a] Compiled from New York Cornell Sta. Bul. 230; Cornell Countryman, 3 (1905–6), p. 59.

[b] Glasgow and West of Scot. Tech. Col. Agr. Dept. Rpts., 6 (1898), p. 14.

The mealy condition is usually found in potatoes with a starch content ranging from 18 to 20 per cent.

As shown by available data, potatoes which retain their form and which are yellowish in color and firm or soggy when boiled are most desired for culinary purposes in France. These qualities are usually found in potatoes with a low starch content and a high protein content, as was shown by extended investigations, including analytical work and cooking tests, undertaken by Coudon and Bussard [a] with 34 varieties of potatoes.

It seems true that Europeans are commonly more discriminating in their selection of potatoes than Americans, since they more generally recognize that certain varieties are better fitted for a definite purpose than others. Thus, varieties which are most excellent for frying in deep fat or for salad making are of poor quality when boiled, and vice versa, and it is quite common for housekeepers to take such facts into account when potatoes are purchased. In Germany two broad classes of varieties are generally recognized, those suitable for cooking and those specially adapted to starch making and distilling purposes.

Whatever the standard of excellence, it is self-evident that conditions which affect table quality are worthy of study.

In an extended series of investigations recently carried on at the New York Cornell Agricultural Experiment Station, by J. W. Gilmore, a number of the factors in the growth and development of potatoes were taken into account which affect their culinary quality, especially when baked or boiled. Though the texture and appearance when cooked were the final tests of quality, the physical characteristics which might be considered as factors regulating quality were also studied and the raw tubers were examined both externally and internally.

As Professor Gilmore points out, our American market demands potatoes 2 to 3 inches long and 5 to 10 ounces in weight, since such potatoes have more uniform cooking qualities, a better appearance when served, a more nearly accurate weight when sold by measure, and sustain smaller losses when boiled. In the northern United States a light yellow or whitish-skinned tuber is preferred, while in some parts of the Southern States pink-skinned varieties are sought.

So far as we are able to determine, the pink-skinned varieties are in general quite as good in quality from a culinary point of view as those of light or yellowish color. The blue and dark tubers are not desirable for table use except for salads and garnishings. Excepting the potatoes put on the market as "earlies," those having a more or less netted skin, or those whose skin has

[a] Ann. Sci. Agron., 2. ser., 1897, p. 290 (Experiment Station Record, Vol. IX, p. 263).

a corky appearance or touch, are usually preferred to the smooth and clear-skinned tubers. This appearance or touch is, in some instances, a variety characteristic, but in general it indicates a degree of maturity or development which promises good cooking quality. On the other hand, the potatoes of smooth and clear skin are oftentimes excessively watery or immature.

The presence of lenticels—that is, bodies of cells which during growth enlarge and rupture the skin (fig. 1)—is not objectionable,

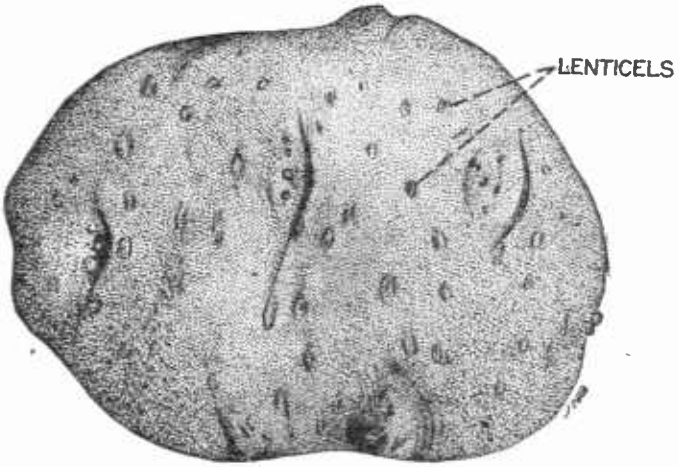

FIG. 1.—Tuber showing lenticels on the surface.

for they usually indicate normal growth and development in a healthy environment.

Potatoes with numerous and deep eyes are * * * objectionable because they may carry much dirt, and the labor, time, and waste in preparing them for cooking are much greater than is the case with potatoes of even surface.

The same objections of time, labor, and waste bear upon potatoes of non-uniform or irregular shape. Tubers having deep notches and quick curves in their surface are usually avoided, while those of oval, flat-round, and elongated-oval shape are most desirable.

In the physical examination the parts considered in the work at the Cornell Station were the surface or skin; the cortical layer or portion immediately under the skin, and varying from 0.1 to 0.5 inch in thickness; the external medullary area, that is, the main starchy part of the tuber lying within the cortical layer; and the internal medullary area or central portion of the potato which often branches into the external medullary area, and is more or less translucent on account of its high moisture content (fig. 2). The texture of the tuber, as indicated by cutting with a knife, was also determined. In general, the physical examination was carried on along the line followed by Coudon and Bussard, whose work has already been referred to.

As regards the surface and texture of the skin, it was noted that uneven tubers with deep eyes were undesirable for market, while a netted skin indicated maturity, and, as a general rule, good quality. A smooth skin indicated immaturity, and hence poor keeping quality and a tendency toward undesirable flavor. Scabby potatoes were often mealy and of good color, but undesirable from the market standpoint. Tubers which had grown in part exposed to the air were heavy and soggy when cooked, and of poor color and undesirable flavor. Compound tubers were not uniform in growth, development, or cooking quality, and were often of poor flavor.

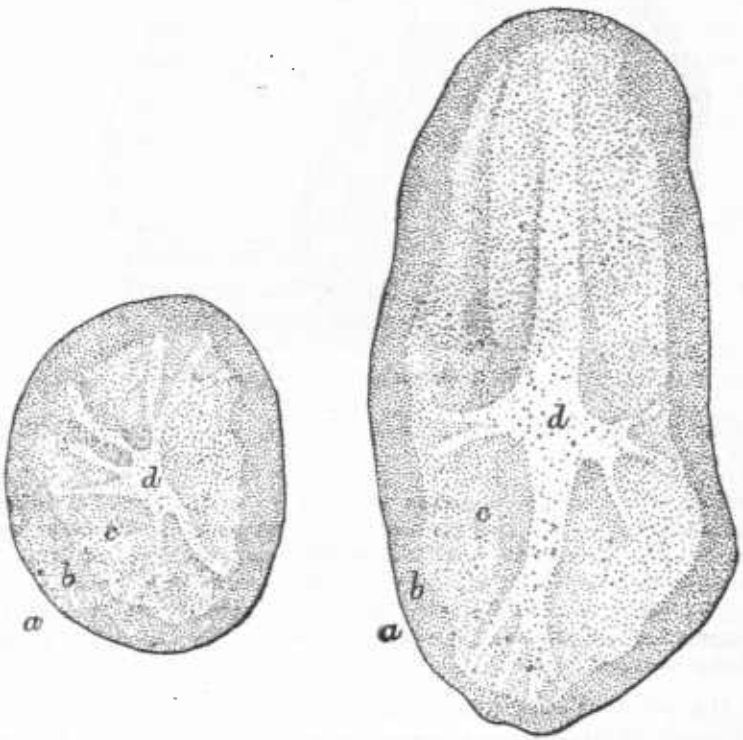

FIG. 2.—Transverse and longitudinal sections of the potato; *a*, skin; *b*, cortical layer; *c*, outer medullary layer; *d*, inner medullary layer.

In general it was found that when the cortical layer is thick and dense, the tubers are of poor quality, and this condition is an indication that they grew near the surface, where the temperature and moisture conditions were more variable than deeper in the soil. A thin and more translucent cortical layer indicates that soil and climatic conditions are more favorable for development. A uniform external medullary area indicates an even distribution of starch cells and of starch grains within the cell. When this layer is not uniform, it is an indication that the starch cells are unevenly distributed and inter-

spersed with watery areas. A large and branching internal medullary area indicates that there is a large proportion of the potato substance which does not contain enough starch grains to rupture the cell walls when the tuber is boiled, and hence a soggy rather than a starchy cooked product results. When the internal medullary area is small, it is an indication of uniformity in the starch area and a small proportion of watery substance. When a potato is crispy, that is, when the cut portion is brittle and snappy, it is an indication of maturity of the starch cells and of a uniform cellular structure with thin walls. On the other hand, a leathery potato, i. e., one in which the cut surface is soft, smooth, and even, indicates an overgrowth in the thickness of the cell walls and very often an inadequate supply of starch:

In cooking, mealiness is the most important consideration in estimating quality. In general, mealiness follows upon the presence of sufficient starch in the cell to rupture its walls when boiled in water. The grains of potato starch expand and coalesce when boiled in water, and if the cells are sufficiently full of these bodies the boiling will cause the cellular structure to be broken down, and a degree of mealiness is the result. When the requisite amount of starch is not present in the cell its walls are not broken down in cooking; hence the tuber retains its form or is soggy.

In Professor Gilmore's cooking tests the varieties included were Doe Pride, Rural New Yorker, Early Michigan, and Wonderful. Doe Pride, it is said, was immature and of decidedly poor quality. It remained soggy and retained its form when boiled, and the loss of weight in cooking was 1.87 per cent. The Rural New Yorker, Early Michigan, and Wonderful potatoes were all mealy when cooked and were of good flavor and color. The Rural New Yorker gained 0.48 per cent in boiling. The Early Michigan and Wonderful lost 2.87 and 6.29 per cent, respectively. All the samples which were baked lost weight, the proportion being 12.79 with Rural New Yorker, 17.46 with Early Michigan, and 20.76 per cent with Wonderful.

These figures and observations seem to point to the conclusion that, although the starch grains expand greatly on boiling (fig. 3), yet the volume of potato substance is not materially increased, because in expanding the starch grains incorporate the water which was originally in the tuber in a free state. In other words, the mass acts somewhat as a sponge. If the cortical layer is thin, the skin netted, and the external medullary area uniform, the texture crisp, and the internal medullary area small, the tuber generally becomes mealy when boiled.

Experiments were made with Doe Pride, a late variety, to study the influence of the daily range of soil and atmospheric temperature on the quality of the tuber. It was observed in 1903 that tubers of this variety growing at different depths varied in culinary properties and in structural characteristics. Further investigations in 1904 showed that the tubers in the soil are generally located above the

seed tuber, and that when they are from 2 to 4 inches below the surface they apparently tend to grow in a sloping position, with the bud end slanting upward. It was also noticed that where the bud end came very near the surface there was a structural difference between this and the stem end, and consequently a difference in quality. Analyses of three tubers gave an average of 21.83 per cent of dry matter, 15.77 per cent of starch, and 2.69 per cent of protein for the bud end, and 25.016 per cent of dry matter, 18.94 per cent of starch, and 2.83 per cent of protein for the stem end.

An experiment in planting at different depths resulted in a larger number of tubers from planting 2 inches deep than from planting 4 or 6 inches deep, but the total weight was smaller. The shallow planting did not allow sufficient space for the development of the tubers between the seed and the surface of the soil, and consequently many of them were crowded out upon the surface. In this test 9 per

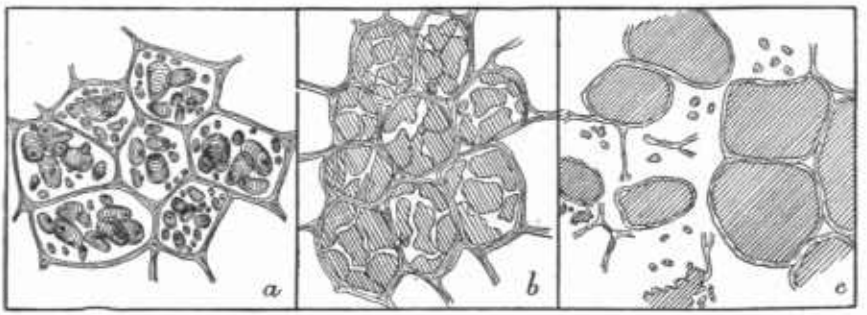

FIG. 3.—Changes of starch cells in cooking: *a*, cells of a raw potato with starch grains in natural condition; *b*, cells of a partially cooked potato; *c*, cells of a thoroughly boiled potato.

cent of the plants of the 2-inch planting bore tubers above ground while the tubers of the deeper plantings were all underground. Most of the tubers were produced at a depth of 2 to 4 inches, and these were also best in shape, size, and quality. Those produced less than 2 inches below the surface of the soil were usually inferior in color, elastic, and coarse in texture, and soggy and heavy after boiling, while those over 4 inches deep were in many cases watery, apparently immature as to starch development and cellular structure, and also somewhat reduced in size. The plat on which the seed was planted 6 inches deep produced the best results as regards number, size, shape, and weight of large tubers. This plat also produced the largest number and weight of tubers of the best quality. The number of scabby tubers on the 6-inch plat was greater than on the 4-inch plat, but they were small and apparently immature, and were produced at the lowest depths. The temperature and moisture conditions were most constant on the 6-inch plat. For the present these observations indi-

cate that good quality is a characteristic of tubers developed under a uniform soil temperature of 65 to 75° F. The highest average in moisture content was also found to exist on this plat.

To study ripeness as a factor of quality, the same varieties of potatoes were planted on May 7 and July 6 in 1903, and on May 21 and July 12 in 1904. Analyses of the tubers showed that immature potatoes are relatively richer in protein and poorer in starch than normally developed and ripened tubers. Late planting very materially reduced the yield, and in both years the late-planted crop was of poorer quality as regards mealiness in boiling and physical aspects. As indicated by cutting with a knife, the tubers were more or less leathery and watery, and in boiling retained their form and were soggy. That the vines of late-planted potatoes die normally at the end of the season is no indication that the tubers have reached that degree of maturity which is essential to superior quality. About 75 to 80 per cent of the immature tubers were attacked by "internal brown," a more or less common disease, originating in the internal medullary area, and manifested by a browning of the tissue and its ultimate contraction and decay.

No experiments have so far been made at the Cornell Station to determine how the texture of the soil influences the quality of the potatoes, but in 1904 potatoes were grown on 2 acres, partly of a fine sandy loam and partly a clay loam of poor drainage, and it was incidentally observed that the crop on the sandy soil was of good quality while the tubers from the clay-loam area remained firm and soggy after boiling and were exceedingly poor in flavor.

The general conclusions reached in the New York Cornell experiments were in effect as follows: The culinary and dietetic quality of potatoes is not dependent upon chemical composition so much as upon the anatomical (and perhaps physiological) characteristics of the tuber and the arrangement and distribution of starch and water areas in its substance. The structural characteristics of the tubers are influenced by the conditions of the soil, and of the soil and atmospheric climate in which the potatoes grow. As a result of these investigations it seems probable that the quality of mealiness of a potato when boiled, and to a considerable extent the flavor, are influenced by the daily range of soil and atmospheric temperature during the growing period, the degree of ripeness of the tuber when the plant dies, and the physical condition and type of the soil.

"Fortunately, the factors which seem to influence quality in potatoes are within control of the thoughtful potato grower. Given a good variety and a good potato soil it is believed that good quality is developed under a uniform soil temperature of 65 to 75° F.; and that great fluctuation in soil temperature is detrimental to the best develop-

ment of potatoes. These facts bear directly upon the depth at which potatoes should be planted, best results being obtained when planted at a depth of from 4 to 6 inches."

The effect of different fertilizers on the cooking quality of potatoes was included in an investigation carried on several years ago by R. P. Wright,[a] of the agricultural department of the Glasgow and West of Scotland Technical College. The tubers selected for cooking were grown on several farms and after boiling were tested by experts. The dry matter and the starch content were also determined. The best results were noted in the case of potatoes grown on land fertilized with superphosphates in addition to barnyard manure. "On the average * * * the potatoes had a smaller percentage of starch when grown on farmyard manure alone than when superphosphate was added to it. The superphosphate also produced a profitable though not a large increase in the total yield of the crop, and it has therefore been a beneficial manure both on quantity and on quality."

In a study of factors affecting the quality and composition of potatoes, which was made by S. F. Ashby at the Rothamsted Experiment Station,[b] and which dealt largely with the causes of the blackening of potatoes after cooking, and especially when they are warmed a second time, a number of different varieties of potatoes were tested which were grown on a variety of soils fertilized in different ways. The results, while not conclusive, showed that the ratio of amid to proteid nitrogen in potatoes of good quality was always high. The indications were that the quality of the potato was determined especially by temperature and water supply and the physical character of the soil.

The best potatoes came from the soils which were neither lacking in the coarse particles (gravel, grit, and coarse sand), which insure porosity and consequently warmth, nor in the finest materials (fine silt and "Klay"), which secure retention of water.

Climate, as affecting the distribution of seasonal rainfall and air temperature, must always play an important part in modifying the value of a soil for raising good quality potatoes, so that, although a light soil of good physical composition produces the best quality tubers in a moist climate, a heavy soil may do better in a warm, dry climate.

The variations included in the above test are, of course, of special interest to English potato growers, but the experiment as a whole is worth attention since it indicates clearly that cooking qualities are being given their due weight in judging of the relative value of different kinds of potatoes; and that these qualities vary with different varieties and with different soil conditions and methods of handling and storing.

[a] Loc. cit.

[b] Jour. Agr. Sci., 1 (1905), No. 3, p. 347.

Elaborate tests of the cooking qualities of potatoes have recently been made[a] in England with a number of standard varieties of potatoes which were grown in Scotland, Lincolnshire, and Essex. Six tubers, weighing as nearly as possible 6 ounces each, were selected in each variety and were placed in cold water, then boiled slowly, and steamed for a few moments, each sample being cooked in a separate pot. When judged by experts on the basis of flavor, texture, and appearance, the Essex potatoes were markedly superior to the others, the highest score being made with Essex-grown varieties known as Charles Fiddler and Sim Gray. The Scotch samples scored the fewest points.

After about twelve weeks an additional test was made to learn the effects of storage on cooking quality. Factor and Warrior (Scotch-grown) were the varieties which were given the highest total score on the basis of flavor, texture, and appearance when freshly cooked. After standing for twenty-four hours the cooked potatoes were again examined, the above-mentioned varieties and several others being unchanged though the majority had darkened and deteriorated.

The investigations which have been cited give an idea of the character and scope of the work which has been recently undertaken with reference to the cooking qualities of potatoes, and it is evident that this important factor is receiving the attention which it merits at the hands of a number of investigators.[b] As Professor Gilmore points out, "the consideration of quality in potatoes has a close relation to the problems of improvement and breeding, and it is to be hoped that in future work along this line quality may be considered as important a factor as yield."

FOOD VALUE OF COTTAGE CHEESE, RICE, PEAS, AND BACON.[c]

During a number of years past H. Snyder, of the Minnesota Experiment Station, has been giving a great deal of attention to the study of the digestibility and nutritive value of some of the more common articles of food, a large part of the work being done in cooperation with the Office of Experiment Stations of this Department and the results published in its bulletins.

In a recent bulletin of the Minnesota Experiment Station, Professor Snyder reports the results of five series of digestion experiments made during the year 1904 with workingmen as subjects, which bring out some interesting facts of practical value with reference to

[a] Mark Lane Express, 91 (1904), No. 3822, p. 769; 92 (1905), No. 3833, p. 334.

[b] Some of the changes brought about by cooking, the structure and composition of potatoes, their digestibility, place in the diet, and related topics are discussed in "The Value of Potatoes as Food," reprinted from the Yearbook of the Department of Agriculture for 1900.

[c] Compiled from Minnesota Sta. Bul. 92.

the digestibility and nutritive value of cottage cheese, rice, peas, and bacon when used in various combinations with bread, milk, and sugar to form rations which were considered palatable and suited to the needs of the subjects.

COTTAGE CHEESE.

During the three days of this experiment the daily ration consisted approximately of 1.1 pounds cottage cheese (or about 6 ounces per meal), 1.16 pounds bread, 4.12 pounds milk, and 0.06 pound sugar, the cottage cheese supplying over 40 per cent of the total protein and about 28 per cent of the total fat of the ration.

The cottage cheese used in these experiments was prepared as follows:

> Separator skim milk was allowed to sour in a warm room. The milk was then heated to a temperature of about 100° F., and hot water 175° F. added at the rate of about one pint per gallon of milk. The addition of the hot water resulted in more complete coagulation of the milk. After stirring for one or two minutes, the coagulated mass was allowed to settle and then the whey was drained off and the curd collected by straining through cheese cloth. If too much hot water is used, a tough curd results; if the milk is not sour enough, it fails to curdle properly. When of medium acidity and favorable temperature, a soft, fine-grained curd is secured. The curd was salted and mixed with cream. The cottage cheese prepared in this way was found to be very palatable and contained a large amount of nutrients in the form of proteids and fat.[a]

The experimental data showed that on an average 95 per cent of the protein and fat and 97 per cent of the carbohydrates which this ration supplied were digested, and that 90 per cent of the energy was available to the body. In similar experiments in which the ration consisted of bread and milk alone, it has been found that 91 to 95 per cent of the protein, 93 to 97 per cent of the fat, and 97 to 98 per cent of the carbohydrates are digested. Since these values are practically the same as those obtained with the experimental ration, it follows that cottage cheese has about the same digestibility as milk and can therefore be ranked with the very digestible foods. "No digestion disorders were experienced by any of the subjects on account of consuming such a large amount of cottage cheese per day. The men were all employed at hard farm labor, and the ration of which cottage cheese formed an essential part gave entire satisfaction."

A pound of cottage cheese like that used in Professor Snyder's experiments, made without the addition of cream, contains about 0.17 pound protein, 0.08 pound fat, and 0.07 pound carbohydrates, which is about the same amount of total nutritive material as is found per

[a] Detailed directions for the preparation of cottage cheese of uniform quality has been given in a previous bulletin of this series, U. S. Dept. Agr., Farmers' Bul. 202, p. 28.

pound in the edible portion of many cuts of meat, but not as much as is contained in meats with a high percentage of fat. "Pound for pound, cottage cheese prepared with cream compares favorably in composition and digestibility with beef and other meats. One hundred pounds of skim milk and 4 pounds of cream, containing 20 per cent fat, will make from 15 to 16 pounds or more of moist cottage cheese. At 2 cents per quart for skim milk and 35 cents per quart for cream, cottage cheese would cost about 11 cents per pound, and compares very favorably in nutritive value with meats at the same price per pound. Where skim milk can be procured at a low cost, cottage cheese is one of the most economical foods that can be used. The addition of cream to cottage cheese favorably influences both its nutritive value and its palatability without increasing the cost above that of average meats. Upon the farm, where milk is produced, cottage cheese is one of the cheapest foods that can be used."

RICE.

This grain is commonly considered an especially digestible food, but the results of the experiments reported by Professor Snyder, in which boiled rice replaced bread in the daily ration, showed that although it is easily digested when well cooked it is not more completely digested than other common cereal foods. It has been found that, in case of bread made from straight-grade flour, about 88 per cent of the protein and 97 per cent of the carbohydrates are digestible. In the case of rice, 83 per cent of the protein and 98 per cent of the carbohydrates were digested, while 90 per cent of the energy was available to the body. It thus appears that the carbohydrates (starch) of rice were more completely digested than the proteids, but that the proteids were not as completely digested as those of wheat bread. The rice samples used in these digestion trials were American grown and of selected types. As shown by analyses they contained a larger amount of nutritive material than is present in the average imported rice, being equal in food value to flours of low gluten content.

In general, it may be said that rice is a food which supplies the body with a large amount of digestible carbohydrates, a pound of rice, like that used in the Minnesota experiments, containing on an average 0.76 pound of digestible carbohydrates in addition to 0.07 pound of digestible protein, which is somewhat more carbohydrates and less protein than is present in a pound of wheat flour. "When extensively used in the dietary, rice should be combined with foods of high protein content, as meat, cheese, and the legumes."

PEAS.

In a number of the experiments pea soup made from dried peas formed a considerable part of the ration, this dish being selected because dried legumes are known to be a cheap source of protein and it was of interest to learn how they compare in digestibility and nutritive value with other proteid foods. The protein of the whole ration was somewhat less thoroughly digested than was the case when cottage cheese was eaten; nevertheless, the peas were fairly well assimilated since the calculated coefficients of digestibility for the protein and carbohydrates of peas alone were 80 and 96 per cent, respectively. These same values were obtained in earlier experiments [a] which were made with dried beans.

"The proteids of peas are not as completely digestible as the proteids of the cereals, particularly of wheat flour. Although the proteids in peas are less digestible than in cereals, the large total amount makes nearly twice as much total available protein in peas as in cereals."

A pound of peas costing 8 cents contains 0.17 pound of digestible protein, which is as much as is found in a pound of the edible portion of any of the common meats. As a cheap source of protein, therefore, peas are a valuable addition to the dietary, particularly for combination with such starchy foods as bread, potatoes, etc., to make a well-balanced ration.

BACON.

Lean bacon which contained fairly large proportions of both protein and fat formed a part of the ration in a number of Professor Snyder's experiments, about 9 ounces being eaten per man per day. It was cut in thin slices and baked or broiled in the oven until crisp and brown. All the fat which cooked out was saved and eaten with the bread and other foods which made up the daily fare. On an average about 90 per cent of the protein and 96 per cent of the fat of the ration containing bacon were digested and about 88 per cent of the energy was available. Calculated values for bacon alone showed over 90 per cent digestible protein and 96 per cent digestible fat—figures which compare favorably with those which have been obtained for other animal foods.

Allowing 5 per cent for waste, a pound of bacon will contain from 0.1 to 0.3 pound digestible protein and from 0.4 to 0.6 pound digestible fat, which is about two-thirds as much as is found in butter. "Lean bacon contains as much protein and about twice as much digestible fat as other meats, making it at the same time and even at a higher price per pound a cheaper food than other meats. Bacon

[a] U. S. Dept. Agr., Farmers' Bul. 169, p. 26.

fat is easily digested and when combined with other foods it appears to exert a favorable mechanical action upon digestion."

Many who are fond of bacon hesitate to eat it since they believe that being very rich in fat it is a frequent cause of indigestion. As has been pointed out by a number of writers,[a] it seems fair to say that in the majority of cases such digestive disturbances are not due to the fatty nature of the food, but to the fact that the bacon was overcooked, or rather cooked at too high a temperature. It is not surprising that this should be the case when it is remembered that fat heated to a high temperature is decomposed and one of the products given off is acrolein, an unpleasant smelling compound which attacks the eyes, makes them smart, and irritates all mucous surfaces. This compound is plainly noticeable in the acrid fumes of burning or scorching fat. When bacon fat is heated to 350° F., this chemical change is brought about to a greater or less extent. Very often bacon is hurriedly cooked in a very hot frying-pan over a bright fire, and more or less scorched fat is an almost inevitable result. When broiled or cooked in the oven, there is less danger of scorching, but under all circumstances great care should be taken to avoid too hot a fire.

MILK.

In most of Professor Snyder's experiments which have been referred to above, milk constituted a considerable part of the diet. A general fact of great practical importance brought out by the investigation as a whole was that when milk was used the actual digestibility of the rations was greater than that calculated from the digestibility of the individual foods used, showing that when combined with other foods milk exercises a favorable effect upon digestibility.

DRY FEEDING AND SELF-FEEDERS FOR POULTRY.[b]

If, by any system of feeding, poultry can be supplied automatically with dry feed in place of wet mash and at the same time maintain their general condition and egg yield, it is obvious that the work of caring for them will be greatly lessened, and such systems of feeding have been tried at different times with more or less success.

H. W. Jackson,[c] a poultry raiser interested in this problem, found that a lot of 19 hens fed corn, "run-of-mill," meat scrap, and oyster shells from a self-feeder for a year averaged 109 eggs at a cost of 11.8 cents per dozen as compared with 96 eggs per hen at a cost of 10.2 cents per dozen from a similar lot fed in the usual way. Difficulty

[a] Recreation, 18 (1904), p. 446.

[b] Compiled from Maine Sta. Bul. 117.

[c] Nat. Stockman and Farmer, 28 (1904), No. 32, pp. 16, 17.

was experienced in getting the hens to take sufficient exercise. In another test covering four months with a ration having a narrow nutritive ratio the average number of eggs laid by the hens fed from self-feeders was 51 and by those fed in the usual way 42, the cost per dozen being 7 and 7.5 cents, respectively.

Other grain mixtures gave similar results, and the recorded data as a whole show "that in all cases the self-feeder pens have led in number of eggs per hen, but generally at a greater cost per dozen, though it is probable that the saving in labor will offset the greater cost. It is also probable that a better understanding of conditions will make it possible to produce eggs in self-feeder pens at a lower relative cost."

The feeding of dry grains and beef scrap from a homemade self-feeder has been a prominent feature of recent investigations carried on at the Maine Experiment Station by G. M. Gowell. Before considering this work it is well to refer to experiments which the station has carried on with the same family of Barred Plymouth Rocks for twenty-five years, and which have resulted in a system of poultry feeding that it is believed can be depended upon to give satisfactory results, since with this system the newer one was compared. In a test which will serve as an illustration of the results obtained under the older system, pens of 22 chickens each throughout the year received 1 pint of wheat early in the morning, a half pint of oats at 9.30 a. m., and a half pint of cracked corn at 1 p. m., these grains being scattered in litter. At 3 p. m. in winter and 4 p. m. in summer they were given all the mash they would eat up clean in half an hour composed of wheat bran, corn meal, wheat middlings, linseed meal, gluten meal, and beef scrap 2:1:1:1:1:1, with one-fourth of its bulk of soaked clover leaves and heads added. Cracked bone, oyster shell, grit, and water were always supplied, and each pen was also given two large mangels daily. Very few soft-shelled eggs were laid, and so far as known not an egg has been eaten during the last five years by hens fed a ration like the above.

The records which have been kept show that 50 to 55 pounds of the dry meals were eaten per hen per year on an average in addition to 18.2 pounds of wheat, 6.4 pounds of cracked corn, 5.8 pounds of oats, 5.9 pounds of oyster shells, 3.2 pounds of dry poultry bone, 2.9 pounds of mica grit, and 40 pounds of mangolds. The straw required for litter has averaged 36 pounds per bird per year. The average egg yield has been about 150 eggs each. It was noted that the amount of food required by the birds kept in this house, where the temperature was at all times above the freezing point, was always less during the winter season than where birds were kept in the colder houses.

Dry cracked corn and beef scrap was compared with a moist mash

like that just mentioned in a test with 300 pullets divided into two equal lots. In each case the chickens were also fed the same kinds and amounts of dry grains in litter during the day and were always supplied with oyster shells, crushed bones and mica crystal grit. Mangel-wurzels were fed during the winter, and in summer when the runs were bare other green feed was supplied. The dry-feed lot had access at all times to dry beef scrap and toward evening was fed cracked corn ad libitum from homemade self-feeders, while the other lot was fed the moist mash of mixed grain and beef scrap in the usual way. The self-feeders (figs. 4, 5, and 6) were wooden troughs, 6 to 10 feet long, with board sides 5 inches high, above which were lath

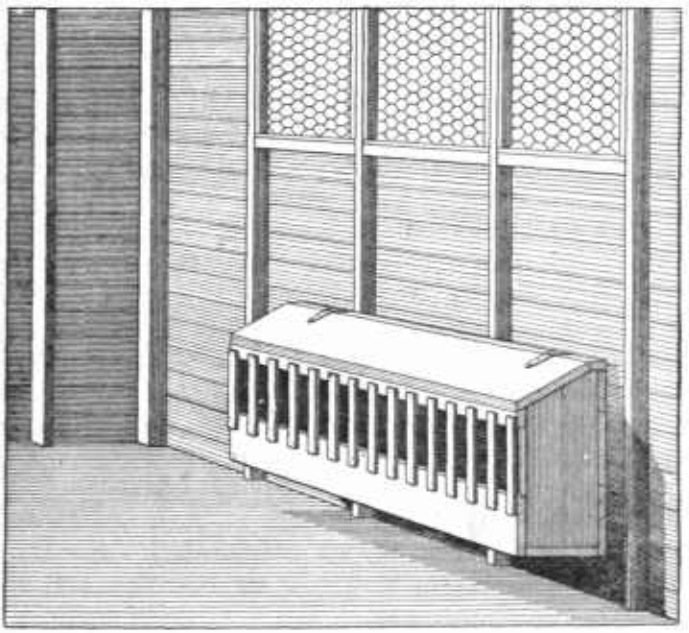

FIG. 4.—Maine Station feeding trough for poultry, attached to inside wall of the poultry house, hinged cover.

slats 2 inches apart, the total height of the troughs being 16 inches. They were provided with roofs which projected 2 inches on either side, and it is stated that no special difficulty was experienced in keeping the troughs clean. The average yearly egg yield on the dry ration was 149 eggs per hen and on the mash 151 eggs, the cost of the feed and straw litter being $1.69 and $1.73, respectively, per hen. So far as could be judged by egg yield, appearance, or health, no marked differences could be noted in the two lots. The lot fed the mash ate per bird per year 53.3 pounds mash, 23.8 pounds wheat, 7.7 pounds cracked corn in litter, 6.9 pounds oats, 8.5 pounds oyster shell, 4.4 pounds bone, 4.2 pounds grit, 8.7 pounds beef scrap, and 40 pounds

mangolds. The average quantity of straw used per bird was 36 pounds. With the lot fed the dry grain the quantities were cracked corn, 45.4 pounds; wheat, 23.8 pounds; cracked corn in litter, 7.7 pounds; oats, 6.9 pounds; oyster shell, 4.4 pounds; bone, 1.7 pounds; grit, 2.9 pounds, and beef scrap, 14.7 pounds per bird per year. The quantities of mangolds and straw were the same as with the other lot. It will be noted that when the birds helped themselves to beef scrap they ate much less than when it formed a part of the mash and that they also required much smaller quantities of oyster shell, bone, and grit.

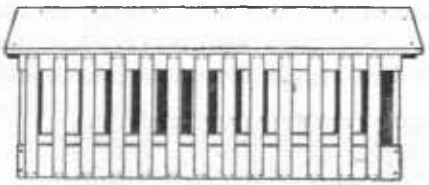

FIG. 5.—Poultry trough accessible from both sides, cover on.

A lot of 550 pullets, which were not selected with special reference to their egg-laying qualities, were also fed experimentally from troughs a dry mixture of the grains and beef scrap used for the mash in the test mentioned above. At first they were not used to the dry mixture and ate of it sparingly, though it was kept constantly before them and they could help themselves at will, but later they ate it readily. When the birds were given their morning feed of grain scattered in litter they were always anxious for it and would scratch in the straw as long as grain could be found before going to the troughs where an abundance of feed was in store. The average number of eggs laid from November 1 to April 30 was 76 per bird. In this test the dry feeding was considered economical as regards time and less wasteful than the more common method.

When they were first put upon this ration they were not acquainted with the dry mixture in the troughs and ate of it sparingly, but in three or four days they were using as much of it as at any later time until they got to laying heavily. * * *.

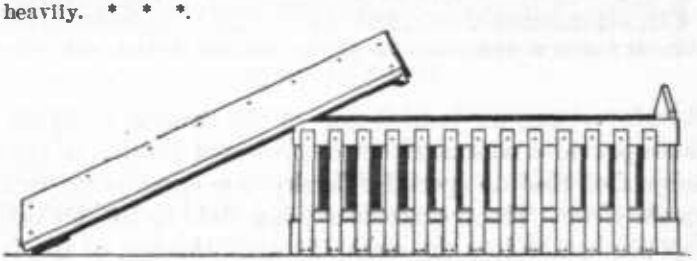

FIG. 6.—Same as figure 5, top removed for filling the trough.

It was very evident that they liked the broken and whole grains [scattered in litter] better than the mixture of the fine materials [fed in troughs]; yet they by no means disliked it, for they helped themselves to it—a mouthful or two at a time whenever they seemed to need it—and never went to bed with empty crops so far as we could discover. They apparently did not like it well enough to gorge themselves with it and sit down, loaf, get overfat, and

lay soft-shelled eggs as is so commonly the case with Plymouth Rocks when they are given warm morning mashes in troughs.

Some of the advantages of this method of feeding are that the feed is put in the troughs at any convenient time, only guarding against an exhaustion of the supply and the entire avoidance of the mobbing that always occurs at trough feeding when that is made a meal of the day, whether it be at morning or evening. There are no tailings to be gathered up or wasted as is common when a full meal of mash is given at night. The labor is very much less, enabling a person to care for more birds than when the regular evening meal is given.

The effects of replacing mash with dry feed were also studied with 1,400 chickens fed cracked corn (or this grain and wheat) and beef scrap kept in separate slatted troughs so that they could help themselves at will to whichever feed they desired. The grain ration for pullets was about three-fourths corn and one-fourth wheat and for cockerels cracked corn only. There were no regular hours for feeding, but care was taken that the troughs were never empty. Grit, bones, and oyster shells were always supplied as usual.

The results were satisfactory. The labor of feeding was far less than that required by any other method we have followed. The birds did not hang around the troughs and overeat, but helped themselves a little at a time and ranged off, hunting or playing and coming back again, when so inclined, to the food supply at the troughs. There was no rushing or crowding about the attendant as is usual at feeding time where large numbers are kept together. While the birds liked the beef scrap, they did not overeat of it.

During the range season—from June to the close of October—the birds ate just about 1 pound of the scrap to 10 pounds of the cracked corn and wheat. They had opportunity to balance their rations to suit themselves by having the two classes of food to select from always at hand. It would seem that we had not been far wrong in our previous feeding, as the birds used just about the same relative amounts of scrap to other food, when they had liberty to do so, that we had formerly mixed in for them.

We are not able to say whether this method is more or less expensive of material than when we fed the four feeds each day at regular hours. As near as we could calculate, there were no appreciable differences.

The birds did well under this treatment. The cockerels were well developed, and we never raised a better lot of pullets. The first egg was laid when the oldest pullets were 4 months and 10 days old.

Attention is called to the fact that the results obtained as yet are insufficient for general conclusions, but judging from the available data dry feeding by the method outlined has given very satisfactory results.

EXTERMINATION OF CATTLE TICKS.[a]

Since 1893, when Smith and Kilborne, of the Bureau of Animal Industry of this Department, published their report on Texas fever,

[a] Compiled from Georgia Sta. Buls. 49, 64; Louisiana Stas. Buls. 82, 84, 2. ser.; U. S. Dept. Agr. Bureau of Animal Industry Bul. 1; and other sources.

an effective method has been known for immunizing cattle against the disease. The method has been further elaborated by investigators at various experiment stations, including Missouri, Texas, Louisiana, Georgia, and others. Although this method of immunization has made it possible to protect against infection a high percentage of northern animals which may be sent to southern States, it has long been recognized that the immunity thus produced is not absolute and that the method is open to certain objections. In the first place, it is a temporary measure, and must be repeated on each susceptible animal before it is safe to ship such animal into tick-infested regions. This means a continuous burden of expense for extra care and arrangement both upon the northern breeder and the southern buyer of blooded stock. Moreover, certain cattle raisers, including August Mayer and others, claim that the process of immunization checks the growth of cattle to a perceptible extent.

Since, according to our present knowledge, Texas fever is transmitted only through the agency of the cattle tick, it has gradually become apparent that the final solution of the Texas-fever problem is to be found in the extermination of the cattle tick. With this idea in view, numerous experiments have been carried out in the Southern States to trace in detail the life history of the cattle tick and to determine practical methods for its eradication. At present there are two general methods prominently before the public. One consists in a simple rotation of pastures, in such a manner that cattle, horses, and mules are kept off from certain pastures long enough to starve out the ticks. After the ticks are thus eradicated on a given pasture it is necessary to allow all ticks to drop from animals before they are allowed on this pasture, or to destroy the ticks on the cattle by dipping or other means; otherwise, a once tick-free pasture will become reinfested. The other method, known as the feed-lot system, consists in maintaining two feed lots within a cultivated field. The feed lots are separated from one another and from the cultivated field by a lane 10 feet or more in width. The feed-lot method is based upon the fact that the period during which the cattle tick is attached to the cattle varies from nineteen to forty days, being longest in winter. Two feed lots are necessary, for the reason that young ticks may hatch from eggs of ticks already fallen from the cattle and the young ticks may reinfest the same animals before all of the ticks have become engorged and fallen off. It is possible, therefore, to avoid the danger of reinfestation by keeping the cattle for twenty days on the first feed lot, at the end of which period a considerable proportion of the ticks will have fallen off and no reinfestation will have taken place. Then, by removing the animals to the second feed lot for twenty days, the remainder of the ticks will fall

off, and the cattle may be removed before they become reinfested. They can then be kept on the cultivated fields previously determined to be free from ticks, and the feed lots should be immediately plowed and thoroughly cultivated, after which the fence corners should be sprayed with kerosene, crude oil, or some other equally effective insecticide, to destroy stray ticks. By keeping the cattle on cultivated land until the next spring the pasture from which they were originally removed will have become free of ticks by the process of starvation. The two methods of pasture rotation and the use of feed lots seem to be somewhat similar and to involve the same operations to a considerable extent. The chief advantage claimed by Morgan for the feed-lot system is that it enables the farmer to free his cattle from ticks in midsummer within a period of forty days.

Both of these methods have been used with considerable success. The apparent failure of the feed-lot method, as tested in Louisiana, was attributed to the absence of tick-free pastures on which to place the cattle after they had been removed from the feed lot, and to reinfestation of supposed tick-free land by inundation.

At a recent meeting of the Association of Commissioners of Agriculture of the Southern States, Doctor Butler, of North Carolina, announced his conviction that cattle ticks could be permanently exterminated. His plan of pasture rotation has been successful in eradicating ticks from 12 counties of North Carolina in the past four years, at a cost of $15,000. No case of reinfestation of land once cleared of the ticks has occurred. In one county where a detailed account was kept of the cost of eradication, the expense was found to be $6 per farm. Butler, Kittrell, of Tennessee, and others were agreed, however, on the point that tick extermination is impossible without laws by which the movements of cattle may be definitely regulated.

All who took part at the meeting of the southern commissioners of agriculture in the conference on the cattle tick were of the opinion that the tick can be exterminated. The benefits to be derived from the elimination of this pest are not hard to find. In the first place, free and unrestricted traffic in cattle between the North and South would be possible. This would mean an extended market for high-bred stock of northern breeders and a great improvement of southern herds and corresponding increase in the number of cattle raised. Southern cattle could then be admitted to northern markets without restriction and would bring a greater price than at present. Furthermore, according to the experience of August Mayer and others, they would come to market matured at an earlier age than is now possible while they are infested with cattle ticks. The Southern States are believed to furnish excellent breeding grounds for cattle, and, with the cattle tick removed, animal industry would undoubtedly

be greatly extended, resulting in a greater production of beef and dairy products and in making possible a more rational system of farming, by which humus would be returned to the soils and the erosion of the soil greatly diminished.

COVERED YARDS FOR COWS.[a]

In a recent circular of the Illinois Station W. J. Fraser presents the views of a number of practical dairymen who have been in the habit of allowing their cows the freedom of a closed shed or covered barnyard and using the stable only at milking time. The data collected seemed so favorable and the plan so reasonable that the method was put into actual operation at the University of Illinois. Twenty-two cows were cared for in this way in a shed 30 by 68 feet, having mangers on each side and bull pens in two corners, and the results were considered most satisfactory.

From the experience at the university the past two years it has been found that the cows keep much cleaner than when stabled and that the milking stable is in a more sanitary condition, consequently it is easier to produce clean milk. By this method there is less difficulty in providing cows with an abundance of fresh air, and they are more vigorous and healthy and have better appetites than when kept in the stable. Since they can move about and get exercise they will not suffer in cold weather if the temperature is somewhat lower than in the ordinary stable. Labor is saved, as the shed can be bedded much more easily and quickly than can stalls; there is little stable cleaning to be done, and the manure is hauled directly from the shed to the field at any time most convenient and when least damage is done the land by tramping. Another advantage is the saving of fertility much more completely. Many barns do not have cement floors, and so there is more or less waste of the liquid portion of the manure. Since land is becoming so high-priced no farmer can afford to allow any fertility to be wasted, and by this method all the liquid is saved, as it is absorbed by the bedding. If only enough bedding is ued to keep the cows clean they tramp the manure so thoroughly that it does not heat to make the air impure. If manure is hauled directly from the stable to the field there is a considerable portion of the year when it must be allowed to accumulate in the yard, where it will leach badly, or it must be hauled on to the land when it is so wet and soft that much injury is done by tramping; this is especially true on clay soil.

On many dairy farms the question of getting sufficient help is becoming such a problem as to interfere seriously with this branch of agriculture. As it seems to be the opinion of the majority of people who have practiced this method that it saves labor, this is one of the strong points in its favor.

The information at hand is not sufficient from which to draw definite conclusions for all sections of the country and all conditions. The system has been a marked success wherever we can find that it has been tried, and it seems probable that it could be put into practice by many dairymen of the State, greatly to their advantage and to the general improvement of the milk supply.

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[a] Compiled from Illinois Sta. Circ. 93.